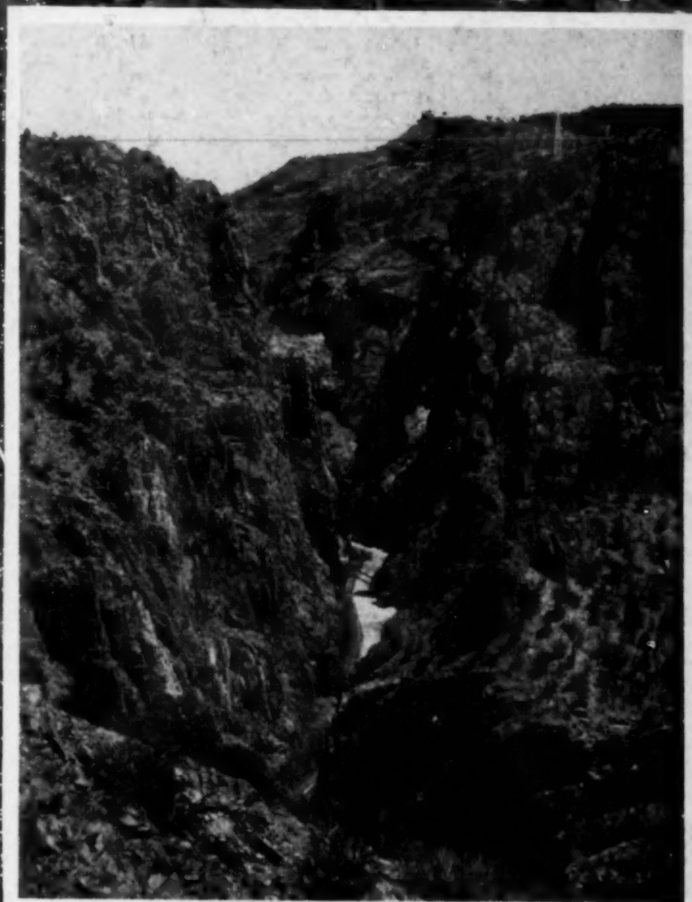
The Earth Science DIGEST



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JULY, 1952

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The Earth Science Digest

JULY, 1952

Features in This Issue . . .

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THE EARTH SCIENCE DIGEST

Box 1357, Chicago 90, Illinois

A Magazine Devoted to the Earth Sciences

R. P. MACFALL — *Business Manager*
B. J. BABBITT — *Editor*

- The Earth Science Digest is open to articles of earth science interest. No manuscripts, photographs or sketches will be returned unless accompanied by ample first-class postage.
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EARTH SCIENCE CLUB OF NORTHERN ILLINOIS
CHICAGO ROCKS AND MINERALS SOCIETY
MARQUETTE GEOLOGISTS ASSOCIATION

These subscriptions are currently available at $50.00.

ANNUAL CONVENTION OF THE AMERICAN FEDERATION OF MINERALOGICAL SOCIETIES, JUNE 26-29, 1952

The Canon City Geology Club invites you to come to Canon City in Colorful Colorado on June 26, 27, 28, and 29, 1952. Canon City is located midway between the two coasts and midway between the two national borders, but neither coasts nor borders are boundary lines for the profound interest of man in the earth sciences. Here, a mile above sea level, the American Federation of Mineralogical Societies and the Rocky Mountain Federation of Mineral Societies will meet in one great convention to study the natural occurrences in the mineral world and to plan ways and means by which these things can be made more accessible and more meaningful to those who care for them. Bring your fine collections of either lapidary work or of nature's work, and place them on display as a medium of visual education in this school of thought. The field is unlimited. Man only is limited.

The roster of speakers is not yet completed, but it will include H. H. Nininger of the American Meteorite Museum with a lecture titled: "Out of the Sky"; also Al Look, paleontologist of Grand Junction, Colorado, whose lecture is titled: "In My Back Yard."

Here from the precipitous edge of the Royal Gorge where the roaring Arkansas River cannot be heard on account of the sheer perpendicular distance above the stream bed, I welcome you most cordially to the convention of the American Federation and Rocky Mountain Federation in Canon City, Colorado.

Sincerely,

H. W. ECKERT
President of the Rocky
Mountain Mineral Societies
and
President of the Canon City
Geology Club

MIDWEST FEDERATION CONVENTION

Convention time is approaching. This year the Midwest Federation of Mineralogical and Geological Societies will hold their annual convention at Macalester College in St. Paul on July 1, 2 and 3. For those of us interested in the many phases of earth sciences this event is a stimulating experience and should rate top priority in your vacation plans for the summer.

The Minnesota Mineral Club in cooperation with the Geology Society of Minnesota are the host societies. Excellent facilities for the gathering are provided at Macalester College, which is located outside the congested areas midway between St. Paul and Minneapolis. There will be no parking problems but a beautiful campus on which to spread out and enjoy yourself.

The program will include a gigantic display of rocks, minerals, lapidary work and geological items by the local societies as well as from the other societies and individuals throughout the Midwest. Commercial dealers in minerals and lapidary equipment will be on hand to supply specimens and cutting material. The exhibit will be housed in the Shaw Gymnasium which will be the center of activities. This is a good sized building with a floor space of 90-135 ft., a much larger area than we had in Milwaukee. All societies are urged to plan to have a display and actively participate in the fun. Lunches will be served on the campus in the cafeteria. A good sized mineral auction will be held. Program lecturers will be conducted in the adjacent Little Theater building. There will be field trips with chartered buses for those not wishing to drive their own cars. Everything is being done to make this Sixth Annual Convention an interesting and enjoyable event that will be long remembered.

To those members and their friends who have not previously attended our conventions let me say that you have really missed something. The opportunity to see what others have been doing in your hobby field and to meet and talk with the many fine people who have mutual interests is invaluable. To those who regularly attend the Midwest conventions I can assure you of another pleasant experience in Minnesota's famed vacation land.

In behalf of the Midwest Federation, the Minnesota Mineral Club and the Geology Society of Minnesota, I extend to you a most cordial invitation to attend.

H. T. PERRY, *President*
Midwest Federation

Canon City Panorama

by Richard M. Pearl

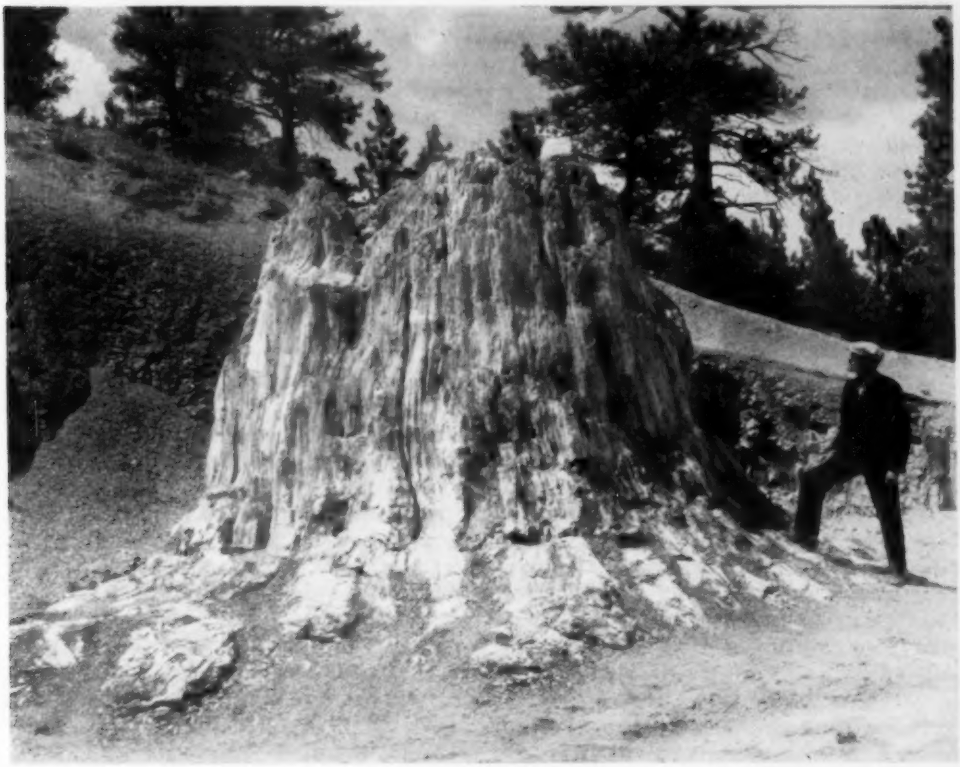
Canon City, seat of Fremont County and site of the 1952 convention of the American Federation of Mineralogical Societies, is the center of a region that is wonderfully varied in its geology and mineralogy.

To the north stands Pikes Peak, its 14,110-foot summit towering over the landscape. From this point the aspect of the great mountain is very different from the more familiar view at Colorado Springs, which reveals the effects of Pleistocene glaciation, scarcely shown on the more gentle side facing Canon City.

The top of Pikes Peak represents a former monadnock, a resistant mass that remained at an elevation while the surrounding land was being worn down to an extensive plain. The rock, known as Pikes Peak granite, is red because of its abundant feldspar of that color.

To the north, also, lies Cripple Creek, still preserving in authentic fashion buildings and mines of the 1890's when it was one of the great gold and silver camps of history. The Mollie Kathleen is operated both as an active producer and as a tourist attraction, with conducted trips into its depths.

The geology of Cripple Creek is volcanic. Perhaps the earlier concept of an ideal volcano, with cone and crater, has been superseded by a milder one of volcanism largely confined beneath the surface, but the area is no less interesting. The ores are tellurides, compounds of gold and silver with the heavy metal tellurium. These minerals are silvery colored, but when



Quarrying Travertine.

heated the tellurium is driven off as a dense smoke, and the yellow gold spots appear on the surface.

Beyond Cripple Creek are two Petrified Forests. Although the wood lacks the rich colors characteristic of Arizona, these commercially owned enterprises are remarkable for the size of the trees, some trunks being 10 to 15 feet in diameter, the largest in the world.

A few miles farther north are the Florissant lake beds. Not long before the explosion at Cripple Creek, other volcanoes burst into eruption and filled prehistoric Lake Florissant with clouds of fine ash. Trapping and smothering birds and insects flying in the air and floating in the water, as well as fish swimming in the lake and plants growing on the land, this ash has perfectly preserved the life of that time. Hardly a piece of the so-called paper shale fails to reveal at least some plant fossils.

The preeminent geologic and scenic feature in the vicinity of Canon City is the Royal Gorge, consisting of the most spectacular part of the Grand Canyon of the Arkansas River, which winds for 34 miles across Fremont County. At the gorge the river has sawed its way into the Pikes Peak granite to a sheer depth of 1,100 feet. The highest suspension bridge in the world takes motorists across the stream, while at the bottom of the canyon run the tracks of a railroad which in places must actually be suspended above the river.

The Royal Gorge is a youthful phase of the terrain, even though it is very deep and cut into very hard rock. It has originated as a result of the uplift of the land, into which the river has been renewed or rejuvenated. As the gradient of the stream steepened, its ability to erode was increased. Thus the considerable depth of the gorge in spite of its youthfulness is the outcome of the rapid rising of the land against the downward force of the water, which intensified the cutting action. The straightness of the walls is partly due

to the existence of large upright cracks in the granite. Successive splitting along the cracks helps to maintain the canyon cliffs.

One of the scenic glories of the Canon City region is not nearly so well known as it should be to those who are intrigued by the story of the rocks. This is the Skyline Drive, where a 3-mile one-way road climbs to the top of the Dakota hogback for a thrilling view 850 feet above the city. Parked on top of the drive the visitor can see how the rise of the Rocky Mountains tilted the sedimentary rocks on end, and how the layers have been affected by weathering and erosion. Hard and soft rocks alternate with each other, the hard layers making ridges while the soft rocks make valleys. This is as true within the Dakota formation as it is in the valleys and smaller hogbacks beneath it.

South of Canon City lie the Wet Mountains, regarded as an extension of the Front Range and separating the Great Plains from the Wet Mountain Valley. Old mining towns in the valley, such as Westcliffe and Silver Cliff, retain much of the atmosphere of the pioneer West. Near Rosita is a quarry of perlite, an igneous rock used as a light-weight aggregate in building blocks.

All three of the major types of rock —igneous, sedimentary, metamorphic— are present in the Canon City region. Metamorphic rocks, however, are subordinate to the others in quantity and importance. Nevertheless, they contain the obscure record of ancient mountains long since invaded by molten masses of younger rock and destroyed by erosion.

Of the igneous rocks in the Front Range and Wet Mountains, the Pikes Peak granite and the volcanic rocks of Cripple Creek are of chief interest. A special variety of the Pikes Peak granite, called pegmatite, is outstanding, for it is the rock associated with the gems and other notable minerals in this area.

From widely scattered cavities in the pegmatite are taken topaz, smoky quartz, rock crystal, amethyst, fluorite, phenakite, and amazonstone. Within the past year superb specimens of blue topaz have been collected among the upper cliffs of Pikes Peak itself. Enormous pegmatites between the Royal Gorge and the main highway west of Canon City yield feldspar as the main commercial product. Specimens of beryl, tourmaline, garnet, and other minerals typical of this sort of occurrence are also common.

The sedimentary rocks of the region are still more varied. Laid down in long-vanished seas and on the floodplains of rivers, they include limestone, sandstone, shale, and the lesser kinds of fragmental and precipitated sediments turned to firm rock.

A large quarry just north of the beginning of the Skyline Drive produces Colorosa travertine of buff color with red veining, and Colocreme travertine of buff with rose veins. This was once a hot-spring deposit, now furnishing attractive building stone for installation throughout the country.

Particular attention should be paid to the fossil-bearing sedimentary rocks of the Canon City area. Close to the city, for instance, have been found the oldest known vertebrate remains, the imprint of a pioneer fish of Devonian age.

The bones and tracks of huge dinosaurs have made Garden Park, 9 miles north of Canon City, one of the most significant burial fields in the world for these reptiles. Skeletons from here are on display in all the large museums. The first recovery of Diplodocus, the most familiar of the dinosaurs, was at Garden Park. Stegosaurus, Brontosaurus, Allosaurus, and Ceratosaurus were likewise at home here. In the Chandler coal mine near Canon City were preserved a series of natural casts of dinosaur feet, along with the carbonized stems of the plants that grew in the swamps and turned to coal.

Any city serving as the immediate center of a region as tremendously varied as this one certainly has a good deal to offer those who may attend an earth-science convention. Canon City is indeed a natural showcase of geology and mineralogy.

EARTH SCIENCE DIGEST RE-ESTABLISHED

In announcing the revival of Earth Science Digest, we are inviting the co-operation of all who are sincerely interested in the Earth Sciences and Earth Science Education in any of its many phases. To insure the continued success of the magazine, and to make it worthy of the constituency it represents, we will need the whole-hearted support of many people.

Without good authors who can contribute articles of worth for the consumption of readers, the magazine would be of little interest to our subscribers. Again a fine subscription list will be needed, for without an extensive reading public to enjoy and absorb the printed information, use it and pass it on to others, the educational function of the magazine would fall far short of the objectives set for it by the sponsors.

Subscribers in turn will be interested in advertisers who can supply their needs and serve them in various capacities. Without advertisers all must realize that it would be utterly impossible to publish any magazine of value at a price that the average person can afford to pay. Advertisers who will serve both the collector and trader intelligently, therefore deserve the support of the reader, and so it will be seen that any such endeavor as we are undertaking must be a thoroughly co-operative venture to succeed.

Last year, when former Editor Jerome Eisenberg was called into the services of the U. S. Army, it became necessary to suspend temporarily the publication of the Digest. To many this move seemed most unfortunate, especially at a time when there appears to be a great upsurgence of interest in Earth Science education of all kinds. Regrets were received on every hand and many expressed their desire and hopes that a way might be found for the magazine to be continued. While there are now a number of excellent publications catering to the amateur mineral hobbyist and lapidary interests, there still remains a definite need for some organ for the dissemination of geologic information and for the promotion of Earth Science, especially in secondary schools of the nation.

In spite of the fine work that has been done to date by all interests working for the cause, through societies, magazines and educational institutions, less than three percent of the students of our secondary schools (high schools) now have the opportunity to obtain formal education in any of the Earth Sciences. With adequate facilities and training in our schools there should be at least one hundred people interested in one way or another in Earth Science hobbies, where there is only one today. Is not this alone worth working for?

Realizing this, your Board of Governors have undertaken the reestablishment of the magazine, and have set for themselves the task of bringing out a publication of which all may be proud. We do not feel that we will be duplicating unduly the work of other publications in the field, but rather we will be supplementing this work from a quite different angle. Furthermore there are many phases of the subject which are seldom touched upon in the literature for laymen, that our editors hope to cover more fully. Among these will be found many splendid articles by authorities upon conchology, paleontology, meteoritics, archeology and other articles having direct bearing upon educational promotion and procedure.

We want all of our readers to have a definite pride and a feeling of partnership in the Digest, and will always welcome suggestions and constructive criticism with the view of being better able to serve your needs. If you are interested in a discussion or article concerning some particular subject, tell us about it, and in due time we will endeavor to supply it. Please remember this is to be your Earth Science Digest, and once more we bespeak for it your fine spirit of cooperation and support.

DR. BEN HUR WILSON, *Chairman*
Board of Governors, E. S. D.

Geologic Features of the Minneapolis-St. Paul Metropolitan Area

by Geo. A. Thiel

The landscape of the Minneapolis-St. Paul area shows a remarkable diversity with numerous lakes and waterfalls, broad deep valleys, rolling terminal moraines and expansive outwash plains. The two cities lie in the midst of a terminal morainic belt that is cut by the valleys of the Mississippi and Minnesota rivers. The St. Croix River occupies a similar deep valley along the eastern border of the metropolitan area and Lake Minnetonka with its numerous bays, narrows and islands occupies an irregular basin in a terminal moraine at the western margin of the area. All of the physiographic features are either directly or indirectly due to the glaciers that moved over the region.

Minnehaha Falls.

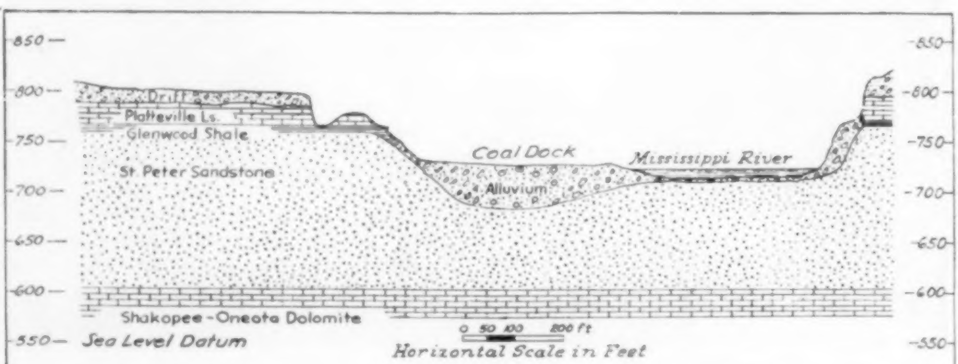
Paleozoic Rocks

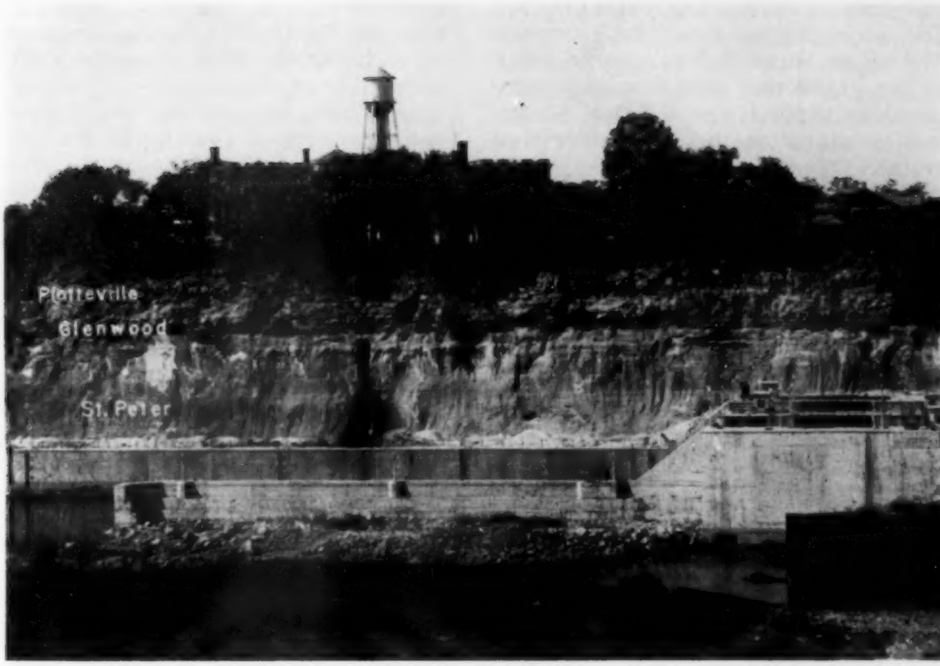
The rocks exposed at the surface in and near Minneapolis and St. Paul are of Cambrian and Ordovician age. Older pre-Cambrian granites occur beneath the cities at a depth of somewhat more than 2,000 feet, but they are not exposed at the surface within a radius of 50 miles. The nearest outcrops of pre-Cambrian are at Taylors Falls which is located in the valley of the St. Croix River about 60 miles northeast of the cities where the pre-Cambrian is represented by basic lava flows of Keweenawan age.

From a study of outcrops and of drill records the following succession of rock formations has been determined:

Rock Formations Beneath the Minneapolis-St. Paul Area

Period	*Formation*	*Average thickness in feet*
Pleistocene	Recent sediments	0 - 100
	Wisconsin drift	0 - 500
	Keewatin	
	Patrician	
	Iowan	
	Illinoian drift	?
	Kansan drift	?
	Nebraskan drift	?
Ordovician	Galena limestone	0 - 20
	Decorah shale	75
	Platteville limestone	30
	Glenwood beds	15
	St. Peter sandstone	150
	Shakopee dolomite	45
	Root Valley sandstone	10
	Oneota dolomite	80
Cambrian	Jordan sandstone	90
	St. Lawrence dolomite	50
	Franconia sandstone	150
	Dresbach sandstone	300
Keweenawan	Hinckley sandstone	100
	Fond du Lac beds	1000
Pre-Cambrian	granite	unknown





The rocks resting on the granite are inter-bedded red and brown sandstones and shales. They are known to occur as far north as the valley of the St. Louis River southwest of Duluth and deep drilling indicates that they extend southwestward beyond Mankato and southward into Iowa. Their type locality is in the wall of the St. Louis River at Fond du Lac, Minnesota. There the massive beds of ferruginous sandstone were quarried and used as architectural stone for many of the old "brownstone" buildings in St. Paul and Minneapolis. The Fond du Lac beds are not exposed near the Twin Cities, but their thickness is known in the deep wells at Lakewood Cemetery in Minneapolis and at Stillwater, east of St. Paul. The former penetrated 1,012 feet and the latter 2,458 feet of red beds resting on an old igneous rock surface.

The ferruginous beds grade upward, usually without sharp contact, into a buff to pink sandstone that crops out along the Grindstone River at Hinckley, a city approximately 75 miles north of the Twin Cities. This formation is called the Hinckley sandstone from its type section in the old abandoned quarries near that city. Even though it is not exposed, the Hinckley formation is of great importance in the metropolitan area for it serves as a permeable aquifer that conducts soft artesian water at a depth of about 900 feet below the cities.

The Dresbach and Franconia are predominantly sandstone, but both contain thick units of siltstone and shale. The Franconia is highly glauconitic, especially the upper part of the formation which is exposed along the St. Croix Valley east of St. Paul.

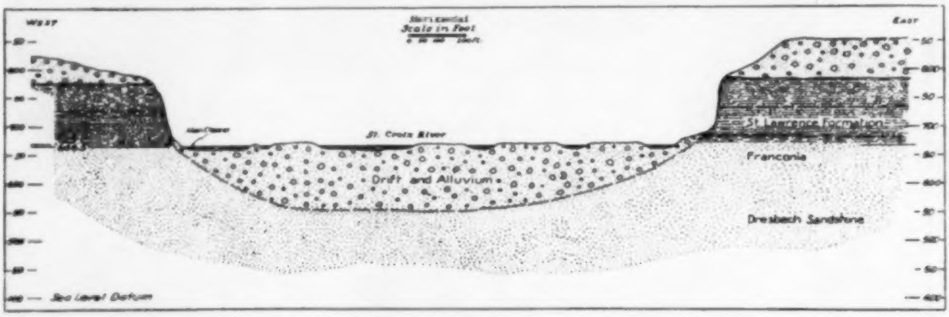
The St. Lawrence formation is exceedingly variable in composition but at its type section in the Minnesota Valley southwest of Minneapolis, it is predominantly buff dolomite that is speckled with grains of green glauconite.

The Jordan sandstone which is the uppermost Cambrian formation, is not exposed within the cities but it has conspicuous outcrops along the Minnesota, Mississippi and St. Croix rivers within twenty miles of the metropolitan centers. The Jordan is a medium-grained white to yellowish-brown sand-

stone that is conspicuously cross-bedded and some layers show ripple marks. The upper 10 to 15 feet contain many quartz grains that have developed crystal faces through the addition of secondary quartz on the rounded detrital grains.

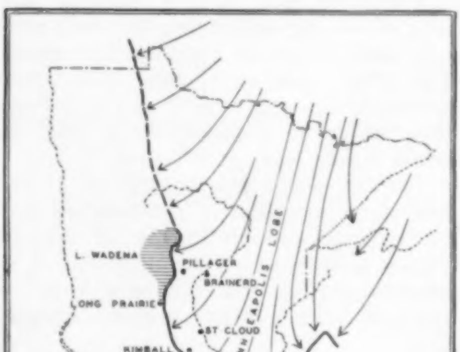
The lower Ordovician is represented by three formations—the Oneota, the sandstone varying from 5 to 15 feet in thickness. There are no good exposures of the formation in or near the Twin Cities.

The Shakopee dolomite was named from exposures in quarries at the city of Shakopee in the Minnesota Valley about 18 miles southwest of Minneapolis. Its appearance in the field is



Root Valley and the Shakopee. In this region the Oneota is only about 80 feet thick and consists chiefly of a buff to gray dolomite. It is well exposed at Stillwater, east of St. Paul, where it caps the bluffs along the west wall of the St. Croix Valley. There the basal beds weather to a rough, porous rock that is used extensively in rock gardens.

The Root Valley is a thin calcareous very similar to the Oneota but it is more calcareous and in many places it is sandy and cherty with many siliceous oolites.



The St. Peter sandstone is approximately 150 feet thick in the Cities and it forms the conspicuous white cliffs from 30 to 80 feet high along the Mississippi River from St. Anthony Falls in Minneapolis to South St. Paul. The formation is a white friable sandstone, much of which has so little cement that it can be scraped from the outcrop with the hand; certain beds, however, have been cemented with silica to form dense hard sandstone. The upper part of the white sandstone contains a mixture of typical St. Peter sand plus coarser, poorly sorted sands from a different source area. This grades upward into shaly beds which are correlated with the Glenwood formation of Iowa and Illinois.

The Platteville formation is the cliff-forming limestone that caps the white sandstone along the gorge of the Mississippi River. It forms the lip of the fall escarpments at Minnehaha and St. Anthony and many less known waterfalls of the region. The natural exposures of the limestone are generally dark gray or buff in color, but

freshly uncovered rock is normally bluish-gray.

The Decorah shale is more limited in its geographic distribution in this area but it lies beneath a considerable part of St. Paul and of southeastern Minneapolis. It is well exposed in a large quarry on the south bluff of the Mississippi River at the west city limits of St. Paul where it is used in making brick. There it consists of 75 feet of alternating bluish-green shale and thin beds of limestone, many of the latter being very fossiliferous.

The Galena formation is predominantly limestone but only the lower 15 to 25 feet are exposed in the metropolitan area and these occur as isolated erosional remnants.

Glacial Deposits

The entire metropolitan area has been covered by glacial ice, but subsequent stream action has removed or modified the deposits along the major valleys. Deposits of Kansan, Illinoian and Wisconsin age have been identified, but the first two are confined to the southeastern part of the area. Two Wisconsin glaciers representing the Cary and Mankato substages left the Patrician and Keewatin drift in various topographic forms.

An old gray drift with partially decomposed pebbles of limestone and shale is found beneath the Wisconsin drift at many places, but it is not exposed at the surface. This material is commonly referred to the Kansan, but some may be of Nebraskan age.

Illinoian or "old red" drift occurs at the surface southeast of St. Paul in the area between the St. Croix and Mississippi rivers, in the region between the villages of Afton and Cottage Grove. It is exposed also along a narrow zone directly north of the north bay of White Bear Lake. Road cuts in these regions reveal a red, sandy and stony drift with many pebbles and boulders of the ancient pre-Cambrian rocks of the Lake Superior region.

The Minneapolis lobe of Cary or Middle Wisconsin age covered the entire Metropolitan area and it left a rugged terminal moraine curving southward around Minneapolis. This moraine together with its outwash plain is a striking topographic feature of the district. Deep cuts through the morainic hills may be seen along any of the highways and county roads north of St. Paul.

After the Minneapolis lobe had receded, the ice advanced from the southwest in what is known as the Grantsburg sub-lobe of the Mankato or Late Wisconsin glacier. Its drift—the Keewatin—is at the surface over the western half of the metropolitan area. The lakes of South Minneapolis and the Fort Snelling prairie are in the outwash that was deposited along the southeast margin of the sub-lobe and Lake Minnetonka lies in one of the morainic belts deposited during the recession of the ice. The Keewatin drift is characterized by the presence of a relatively large number of limestone and shale fragments. At places it contains numerous calcareous concretions. Near the surface it is gray to tan in color but at depths of from 20 to 30 feet the unoxidized material is dark, bluish-gray. It is commonly referred to as the "young gray drift."

(*Concluded on page* 38)

Adventure in Utah

by Donald H. Frazier
Cedar Grove, New Jersey

The state of Utah has prepared a feast for whoever is trying to become an Earth Scientist. The tables are set on the road between Vernal, Utah and Green River, Wyoming. The food for observation and thought is fully labeled with sturdy, decorative, wood-carved signs. Every turn in the road offers a fresh Cambrian, Ordivician, Triassic, Jurassic, Cretaceous or Pleistocene landscape. Even the sub-headings such as Mourey shale, Madison limestone Morgan, Carmel and Niobrara formations and Dakota sandstone are carefullv marked. All of these ancient deposits of the disintegrated and drowned mountains of long ago, metamorphosed, glaciated, eroded, stratified and intruded upon by igneous material are exhibited to the eye within the space of a few miles.

The locus is accessible from either end but the smart driver will prefer to take off from Green River. Without strain or fuss the road leads over high arid country south to Linwood and Manila, two towns which straddle the Wyoming-Utah border. There the fun begins. For the next twenty miles the learned have given names to the land that the unlearned might learn. Mile after mile the road winds up to the top of a pass with each earth-secret named. A splendid forest, an occasional trout brook and flowers as only the West can produce them are thrown in for good measure.

The top is a well wooded plateau boasting a few lovely lakes and a town consisting of one store, its gas pump and 2 or 3 bunk houses—Green Lakes, by name. Nearby is a government camp site for tenters, trailerites or sleeping-bag campers. When we were there a Utah road survey crew was staying at the store, thus lending promise that this area too would soon hear the brassy horn that is sometimes called progress. We were lucky enough to have the camp site all to ourselves.

A mile and a half off the road via "an automobile trail" which bumped along over the plateau's rough surface we came to the Horseshoe Canyon of the Green River. Immediately we began to prepare a supper which was about an hour overdue. Little did we know of the experience that was in store for us.

"We" and "us" refer to ten year old Bonnie, Bill who was eight, Mary five, their mother who is mature but still a romantic rock hound, and the writer, a garden variety of preacher who is impressed by the fact that before ever the mountains formed and long after they will have been cast into the midst of the seas, God is God.

Well, mother was sitting on the edge of the 3000 ft. wall meditating on the sunset. The girls were spreading a blanket and posting the dishes and silver. Bill was scurrying around for sticks to feed the fire and I was sitting on my heels watching a stew and a pot of coffee. Suddenly the evening stillness was rent by tremendous blasts accompanied by heavy crashing, crunching, grinding and sliding into the canyon below. We jumped to our feet in time to see the opposite wall of the canyon break loose to go tumbling into the river. Then came the excited quiet of the moment after, a quiet punctuated by the settling of a single rock now and then.

As we peered into the dim gloomin' of the canyon bottom the dust began to rise in billows. Up and up the side the great cloud lifted until it was just level with the top of the wall. There it began to crawl sidewise along the rim of the canyon like pipe smoke clinging to a table top. An hour later it was a moonlight night with a thin line of grey still marking the opposite rim a mile away.

Bumping back to the campsite we were a very subdued and happy family, each member thinking his own thoughts

and each ready for a night's sleep. But sleep would not come easily. The children were too excited; mother was not sure that the cattle guard would be sufficient to keep our tiny fenced-in camp from being overrun by range cattle. And father? — well, I was wondering whether we had been sufficiently alone on the canyon wall to have at last a definite answer for the old philosopher's question, "Is there any sound when a limb falls from a tree if there is no one there to hear it?"

The next morning we went back to examine the wreckage of the night before. But so wonderful is nature's ability to cover her wounds that we could not define with certainty a single spot that has participated in the break and slide. Of course, we were looking across a mile of space to the opposite 3,000 ft. wall. However, all about us on our side we could see crevices of varying depth and width which gave an indication of what probably had happened. For water and ice, the sun's heat and cold, the rootlets of trees and other forces were obviously at work on our plateau, and that work was being carried on with greatest vigor out near the canyon rim. These were the same processes which caused Robert Frost to write, "Something there is that doesn't love a wall, that wants it down."

To conclude the story of this little episode let me say that we are deeply grateful to the state of Utah for the wayside education it offers in this Green River Canyon area. Allow me also to say by way of moralizing a bit that this family is agreed that it is very wonderful to be alive in an era when the earth is full of wrinkles and also full of earth scientists who puzzle over the wrinkles.

Mrs. Donald Frazier and crevice on edge of Horseshoe Canyon of the Green River, Utah.

RADIOCARBON DATING

Radiocarbon dating, which has revolutionized man's knowledge of the past, depends upon the existence of some 80 tons of radioactive carbon atoms scattered throughtout the world. The first complete description of techniques for counting the elusive radiations of this widely scattered radiocarbon is contained in a new book by Willard F. Libby, *Radiocarbon Dating*, published by the University of Chicago Press.

Libby, professor of chemistry in the University of Chicago's Institute for Nuclear Studies was one of the discoverers of this natural radiocarbon. He developed the techniques for its use in measuring the age of certain archeological and geological remains. His studies so far have set the Ice Age 10,000 years instead of 25,000 years in the past, dated the world's oldest village, confirmed the date of one of the oldest known Bible manuscripts, and contributed vital dates to the history of the first men in America. Libby's methods have been adapted for use in other institutions, and opened up an entirely new approach to the study of the earth's past.

The radiocarbon is produced in a series of natural atom-smashing events that are most active some eight miles above the earth's surface. Cosmic rays carrying an energy wallop thousands of times greater than that produced by man-made atom smashers enter the atmosphere from outer space. There they shatter the nuclei of atoms of atmospheric gases and produce particles called neutrons. These neutrons, which exist only about twelve minutes, in turn bombard atoms of nitrogen, the most abundant gas in the earth's atmosphere. When a neutron enters an atom of nitrogen 14, it most commonly produces an atom of radioactive carbon 14 and an atom of hydrogen. Other reactions, including the production of tritium, associated with the hydrogen bomb, may also take place. In a short while, the radioactive carbon combines with oxygen in the air to form the gas carbon dioxide. The carbon dioxide is taken up by plants as a part of their normal living activity. Animals eat the plants, and the "tagged" carbon dioxide passes into their bodies.

Once the plant or animal dies, the radioactive carbon content is no longer replenished by food intake. It decays back into nitrogen 14 by giving off a beta ray, which is an electron. Because experiments have checked the rate of this decay, it is possible to determine, within certain limits, how long ago the particular plant or animal died by counting the radioactivity remaining in the sample. Half the radioactivity in an uncontaminated sample will, regardless of outside influences, decay in approximately 5,600 years.

The big problem was devising ways of measuring the extremely faint remaining radiocarbon. The radiation of the radiocarbon can be picked up by a Geiger counter and registered at a rate of some six counts a minute. But the normal radioactivity which continually exists as a background in the atmosphere is at a rate of some 500 counts a minute, and would ordinarily blanket the radiation from the radiocarbon.

Libby solved this difficulty by building a special screen wall counter, in which the sample itself becomes a part of the counter wall. This is done so that the comparatively weak radiation from the sample need not pass through any intervening shielding. The screen wall counter is surrounded by eleven shielding counters. The background radiation must come through these shielding counters before it can strike the central screen wall counter. Electronic hook-ups and the anti-coincidence shielding counters eliminate radiation which strikes both the shielding and the central counter and makes counting of the sample more accurate. The outer shielding of eight inches of iron cuts down the initial background count to about 100 a minute. The shielding counters reduce the background count to about five a minute.

The sample of material to be counted —charcoal and well-preserved wood are

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CHUBB CRATER — Toronto, Canada

by Dr. V. B. Meen*

Director, Royal Ontario Museum of Geology and Mineralogy

This paper was first read over the air on WGY "Science Forum," Feb. 21, 1951.

On July 21, 1950, I set foot on the rim of a gigantic crater in Canada's Arctic. This crater is far larger than the world-famous meteorite crater in Arizona. It is located in the north-western tip of the provice of Quebec in the region known as Ungava and is about sixty-one miles from the nearest point on Hudson Strait.

It was hard to believe that I was really at the goal at which I had been aiming for so many months. My planning for this expedition had begun five months before when a prospector named Fred Chubb brought me an aerial map and an aerial photograph which showed the crater. The photograph had been taken by the Royal Canadian Air Force in 1948.

On the map the crater was shown as 11,000 feet across and containing a circular lake 10,000 feet in diameter. By measurements of the photograph we estimated a height of 500 feet for the rim of the crater. The fact that a high rim surrounded the lake ruled out the possibility that it occupied a sink-hole caused either by the melting of a buried block of ice after the ice age or by the dissolving away of limestone rocks in a subterranean cavern, the roof of which had finally collapsed.

This left only two other possible causes for the crater. It must be either an extinct volcano or a meteorite crater. The fact that the crater showed most remarkable symmetry indicated that it was post-glacial in age, otherwise it would have been levelled off and filled in. Since no volcanic rocks or signs of volcanic ash had been noted in that part of Quebec or along the coast, I did not consider it likely that the crater was of volcanic origin. This left a meteoritic origin as the most likely but a crater so large was almost unbelievable.

Map showing location of Chubb Crater —Map by Geo. McCauley.

Mr. Chubb, however, hoped for a volcanic origin. He knew that diamonds occur in extinct volcanoes in South Africa and he hoped that this crater might indicate such conditions. His hopes were boosted further by the fact that diamonds have been found in the United States in gravels which have been transported there by glaciers which originated in north-eastern Can-

ada. Who could tell which of us was right or, for that matter, if we were both wrong?

The crater is located in a part of Canada which is virtually unknown and published data concerning it were practically non-existent.

It was difficult to obtain the money necessary to buy equipment and carry us to this distant spot in order to study the crater, determine its origin, and stake it if it proved to be volcanic. However, it was finally found and the transportation was supplied by the Globe and Mail Publishing Company of Toronto, through the efforts of their staff writer Ken MacTaggart who accompanied us.

We left Toronto on Monday, July 17, and flew by way of the lower St. Lawrence, across Quebec and Labrador to Ungava Bay, and then northwest to the crater. The total air distance was about 1700 miles.

Due to bad weather we did not complete the journey until the following Friday. However, the numerous stops for refueling and to wait for weather ahead of us to clear, gave us excellent opportunities to visit with the Eskimos of Ungava and increase the scope of the feature-length motion pictures which we made of the trip. Our photographer was Robert Hermes of Buffalo, well-known for his wild-life photography.

Flying north across Labrador and Quebec, we had noticed that the trees were becoming fewer and stunted. A few miles northwest of Fort Chimo on Ungava Bay, the trees disappeared completely and the country became entirely barren. Finally, after about one hour and twenty minutes out of Chimo, a low hill appeared dead ahead; and as we approached at about 8,000 feet elevation, the hill appeared to open up and disclosed a lake in its interior. It was our crater, our goal of five months!

We circled the crater twice and then swooped down into it in order to get a close look at the inside walls. The whirr of the motion picture camera and the clicks of several still cameras were almost continuous.

We landed in a fairly large lake to the northwest. Neither this lake nor the lake in the crater had been previously named so we have named them Museum Lake and Chubb Crater Lake. This latter was named as a tribute to the very intelligent curiosity of Fred Chubb which started the whole investigation. The association of the name Museum with Chubb Crater will, I hope, keep constantly before the public of the world the fact that

Aerial photograph from 20,000 feet of Chubb Crater and Museum Lake.
—Royal Canadian Air Force Photograph.

Chubb Crater, looking southwest across the rim.—Photo by V. B. Meen.

museums are continuously carrying on research.

A sectional canoe was part of the equipment of the plane and, as soon as we had landed, it was assembled and launched so that a suitable anchorage could be located for the plane. The equipment was ferried ashore and camp established on the sand beach at the end of Museum Lake nearest to the crater.

The beach was about 150 yards long and 25 yards wide. Beyond it in all directions was an endless expanse of boulders. No tree or shrub grows in the land, and no plant was seen taller than six inches. The most common plants were reindeer lichen, crowberries and moss campion. No mammals were seen at all. The most common birds were the snowbunting and the American pipit. We also saw one or two each of the common loon, Canada goose, duck, rough-legged hawk, gull, rock ptarmigan, Lapland longspur, and northern horned lark. Lake trout were caught in Museum Lake and one minnow was seen in the crater lake. This was literally the first warm day of the summer and the insects were few. This was a welcome surprise because mosquitoes and black flies are at their worst in the Arctic.

Our camp consisted of three small tents fitted with inside poles, and cooking was done on gasoline stoves. There was nothing in the country, not even the moss, which would burn. Although the sun dropped below the horizon for a few hours, it remained bright daylight all the time.

Snow still remained in many places on the north slopes of the crater rim. Although Museum Lake and all the other lakes of the area were free of ice, Chubb Crater Lake was three-quarters covered with floating ice three feet thick. The ground was frozen to within ten inches of the surface. Although the air temperature did reach 70° once, it was usually much lower and it froze each night. The temperature of the water of Museum Lake was about 38°.

From the camp to the nearest part of the crater was nearly two miles. But it was the worst two miles I have ever walked. There is no soil, nothing but large and small fragments of granite. Fred and I made three trips to the crater and on the last one we made a complete circuit of the rim. It took us more than twelve hours. It is over six

and one half miles around the top of the rim and in addition we had the distance to and from camp.

The inside of the crater rim rises out of the lake at an angle of approximately 45°. The outside slope is about 25°. Even a 25° slope is steep but a 45° slope is one that is seldom encountered. The top of the rim is nearly flat and is so broad that when we stood in the middle we couldn't see down into the crater or out into the outer plain.

is on the northeast and the lowest on the southwest. It is broken in a number of places by great trenches which cut through it. Some of the trenches are truly tremendous, being up to two hundred feet deep! The rock which used to occupy these spaces has been blasted out, and dumped as ridges in the surrounding countryside. They are like the splatters made when a drop of ink lands on a sheet of paper.

The water level in the crater is fifty

V. B. Meen surveys interior of Chubb Crater from the rim. The high points in the background are 500 feet above the surface of the lake.—Photo by F. W Chubb.

At first approach, the rim seemed to be a jumble of broken fragments of granite dropped at random into their present positions. On more thorough examination, I realized that the rim represented a mass of granite bed-rock which had been shattered by a tremendous explosion and had been lifted bodily to its present position. There is a regular pattern to the shattering. Fractures run out radially and the granite blocks are tipped gently outward too.

The crater rim rises 300 to 550 feet above Museum Lake. The highest part

feet above that in Museum Lake. Due to fear of leaving our aeroplane unprotected in case of storm, and our inability to take our one canoe overland, down into the crater and back in one day, no measurements of the depth were obtained. An eerie stillness, accentuated by the tinkling of moving ice, added to the awe induced by the shape and great size of the crater. The wind blowing continuously across the top of the crater was the apparent cause of a distinct vibration in the air.

At about three-fifths of a mile and again at one mile from the rim, ridges

of jointed granite rise above the level of the fragments. These appear to be ripples in the bed-rock produced by the gigantic explosion which created Chubb Crater.

Nowhere is there any sign of volcanic activity. This mammoth crater cannot have been formed by any other means than by the explosion of a meteorite. But where is this meteorite, this visitor from space which sometime, five to ten thousand years ago, collided with us and produced a hole as wide as Manhattan Island, measured along Forty-Second Street? There can be no question that the explosion which produced Chubb Crater was one of the biggest experienced on this earth in reasonably recent times. Any explosion which can hurl 5,000 million tons of granite out of a hole is not small. It is quite possible that the meteorite itself was completely pulverized.

I hope to go back with a larger party and much more equipment hoping that we will obtain positive proof that Chubb Crater is a meteorite crater. As such it will take its place at the top of the list of meteorite craters. The biggest so far found on earth!

Members of expedition on permanent snowfield on Chubb Crater's outer slope. Photo by Robert C. Hermes.

Granite fragments which litter the plain outside the crater.—Photo by V. B. Meen.

Etching Polished Mineral Surfaces

by Wm. H. deNeui
Minnesota Mineral Club

The purpose of this article is to describe a simple method for etching the polished surface of agate, marble, glass, etc. by sandblasting suitably stenciled surfaces with powdered carborundum grits.

Possibly some of you have already been doing this but I have never heard or seen the subject discussed, so do believe it may be a welcome new interest for many of you.

The equipment I assembled and use for this purpose is of the simplest, and I will describe it only briefly as I know it is capable of infinite variation and improvement, all depending on each individual's ingenuity, mechanical ability and resources. The mechanical end (as opposed to the artistic) achieves only one objective—that is, to propel the carborundum grits against the polished surface with enough force to scar the surface.

Equipment

Figure 1 illustrates the blasting nozzle; the compressed air passes through it, picks up the grits as they flow from the inverted container, speeds them up through the tapered nozzle, and throws them against the subject. A section of copper or gas pipe will do —3/8" to 1/2" diameter. My nozzle is the tip section of an oil can spout, the remainder of the oil can being the grits container.

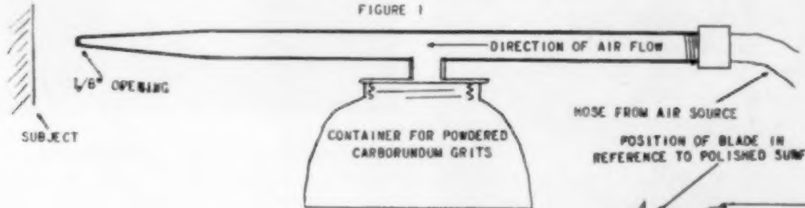
Figure 2 is a sturdy carton about 15" in each dimension. Provide a muslin top, weighted all around. This lets out the air but catches the grits. Install a glass window for watching the work, a piece of inner tube through which the nozzle is inserted, and an inside light. Carefully seal all joints in the box with masking tape to avoid loss of grits.

The subject may be taped to a block of wood or stone and stands on the floor of the box while being blasted.

Source of Air

I use an old diaphram type compressor—designed to operate an ordinary paint spray. A 1/4-H.P. motor runs it, and it provides plenty of volume and pressure for the job. Any kind of com-

FIGURE 1



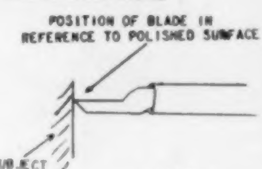


FIGURE 3
TYPE OF KNIFE USED IN CUTTING STENCIL

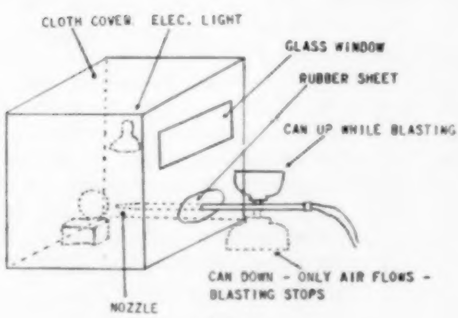


FIGURE 2

FIGURE 4
TWEEZERS

pressor will do. You might even arrange to use a double action tire pump. The actual blasting takes only a few minutes.

Operation

The blasting is the easy part of the job. Mount your prepared subject on the floor of the box, stick the nozzle through the rubber sheet, turn on the air, twist the nozzle so the can is on top and hence in the upside-down position which lets the grits flow into the air-stream, and you're on your way.

Inspect the subject frequently. You'll want to see that you get into all corners, that you cut deep enough to destroy the polish, that you aren't cutting too deep, etc. You'll soon learn where to hold the nozzle—I find that mine should be from ½″ to 2″ from the subject, depending on type of pattern and material being worked on.

Use your grits over and over. All I've had "in circulation" is one pound which just fills my oil can. I've used No. 80. Perhaps a finer or coarser grit would produce work more to your liking.

Preparing the Subject

1. Your subject is a piece which you have already polished — be it slab, sphere, cabochon or whatever.

2. Cover the entire surface with masking tape (get it at any paint store). An old chair caster will help you roll it on smooth and tight.

3. Draw on your design in sharp pencil. Cigarette lighter fluid is excellent for the erasures you'll be sure to have to make.

4. Cut the stencil. Remove the tape from the areas to be etched—leave it carefully on the areas to be left polished. You'll find the type of knife shown in Figure 3 excellent for the job. If held as shown, it can turn hairpin corners smoothly, and also will hold its cutting edge longer, since only the very point rides on the stone. Dental tweezers (Fig. 4) are a big help in removing the small bits of the cut-out pattern. Holding the work under a 3″ or 4″ reading glass, suitably mounted, is also practically a must.

5. When the stencil is finished, examine it very closely under strong light. *This is the critical moment.* The least little shred or speck of the rubber adhesive left in the wrong place, will repel the grits and leave an imperfection on the finished job.

6. Now blast the subject as outlined above and finally, when that is done—

7. Remove the stencil from the subject and behold!—your completed work of art in all its glory!

And now a word about material and type of designs.

Actually my own experience is still so woefully limited I hesitate to advise, but nevertheless this much I have learned, and you might as well have the benefit of it.

Use material showing the greatest contrast between the etched and the polished surfaces. Dark material, with as little natural pattern as possible. (for extreme examples, black obsidian) is excellent—pale grey striped agate is very poor. Or perhaps you'll be able to utilize the natural color pattern of the stone by somehow building your design into it, and to accentuate it.

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The British Royal Jewels

by J. D. Willems

Crowns are the mark of royalty—the jewelry of kings. It takes a stout heart and, according to the poet, a restless head to wear one. Not many are left in our turmoil-stirred world that are adequate.

Among those who have worn their crowns with distinction in recent times, King George VI of the British Empire was outstanding. Appropriately, his crown was the most momentous piece of jewelry existing in the world today. Together with his sceptre and the orb, it was seen in thousands of photographs all over the world resting upon his coffin. These were the marks of his royal station, his power and authority, once great and still honored and respected.

Crowns are going out of style everywhere. Few are left, many have fallen, never to be worn again. Others have been dismantled or have become lost. An era is coming to its end, an era of pomp and splendor. It is safe to assume that no new crowns will ever be created. Of those still in meaningful existence, few will last much longer than a generation or two.

Crowns are representatives of the highest expression of the goldsmith's art. The jewelry designers' most expressive urge could find its outlet. Creative geniuses of sufficient stature to do justice to a king or queen have been far fewer than the royal persons who wore the crowns. The workers who shaped and molded the most precious of all metals to prepare them to receive and display the world's finest gems will soon lose their jobs. Large and rare diamonds, emeralds and rubies henceforth will not find their way through natural channels into magnificent crowns of royalty, but will be divided and cut into smaller pieces to be offered to the multitude.

It is a fact that the finest crowns that have ever been fashioned are those of England. There are seven in all; three for the King, three for the Queen, and one for the Prince of Wales. Of these the most important crown is the one that was seen upon the red velvet cushion on the King's plain wooden coffin, the Imperial State Crown. This crown was produced in London by Rundell and Bridge, in 1838 for the young Queen Victoria. The crown weighs nearly three pounds. Into it were placed many of England's most ancient and honored gems. The best known and the most honored is the Black Prince's ruby, clearly seen in the front. This remarkable gem is of irregular shape, preserving to some extent the contours of the rough stone

Imperial State Crown of England.

in the form of a cabochon. Although it is not a corundum but a spinel ruby, it nevertheless occupies the place of honor in the crown due to its traditional importance as well as its beauty.

This crown also carries the second largest diamond in the world, the Star of Africa II, on the front below the ruby. On the back of the crown is located the great Stuart sapphire of

Charles II (not visible in the picture). On the front of the cross-patee at the top of the crown is set the sapphire of Edward the Confessor, a large gem of magnificent color. From the four points of the arches at the top are suspended two large egg-shaped pearls, once the earrings proudly worn by Queen Elizabeth, the First

In addition to these grand and stately stones, this crown contains four large rubies, eleven large emeralds, sixteen large sapphires, 277 pearls and 2783 smaller diamonds.

The crown is indeed priceless; no value has ever been made public. It is considered the most valuable and the most beautiful piece of jewelry in the world.

The King's Royal Sceptre, originally designed and created by Sir Robert Vyner, is also seen in the photographs. It is a rod of gold three feet long, and symbolizes the King's power and authority. At the top, just beneath the cross is an amethyst sphere of great beauty and remarkable size, faceted

The King's Royal Sceptre.

all over. Above the orb is the cross-patee symbolizing the spiritual above the mundane. In the center of the cross rests a large beautiful emerald.

The dominating feature of the sceptre is the largest diamond in the world, the Star of Africa I. It is cut in the shape of a drop held in place by a set of six golden prongs, which hold the gem in their clasp. These clasps

The King's Orb.

can be opened and the diamond removed, to be worn as a pendant when the king or the queen so desires.

The whole of the sceptre is built upon a remarkable groundwork of gold arches, scrolls, sprays and curves of most elaborate and intricate design.

The King's Orb, the third object of the royal jewels seen in the photographs, consists of a sphere surmounted by a cross-patee, symbolizing the domination of the Christian religion over the Earth. This golden ball is six inches in diameter. The most remarkable gem is the amethyst at the foot of the cross, cut with facets and of striking color. It is one and one-half inches in height. The orb was designed and created by Sir Robert Vyner around 1662, A.D.

Excellent models of the two largest diamonds, the Star of Africa I and II, can be seen in the gem room of the Chicago Natural History Museum. They represent accurately the size, shape and proportions of these royal gems.

Earth Science Emphasis Week

A Report by Dr. Ben Hur Wilson, Chairman

Educational Committee of the American Federation of Mineralogical Societies

As a focal objective, Earth Science Digest has been dedicated to the promotion of Earth Science Education by every practical means at its disposal. We are especially anxious that it be introduced into the curriculum of the Secondary Schools.

It is at this level where we find the most inquisitive, impressionable and receptive minds, always appreciative of any information which may acquaint them with the many phases of their physical environment. Earth Science makes for more wholesome mental attitudes, which is reflected, without doubt, ultimately into better citizenship as the student develops and reaches maturity. This alone is sufficient reason for us to encourage the pursuit of the subject.

Many agencies, including strong committees from both the American Federation and the American Geological Institute, are attacking this problem, and only last year the Earth Science Emphasis Week, having these objectives in mind, was sponsored by members of the Earth Science Club of Northern Illinois, on October 8th through the 14th, 1951. The objectives of this endeavor, as suggested by the Illinois Regional Committee of the A.G.I., were three fold, as follows:

(1) To stimulate local interest in Earth Science Education, particularly as it might contribute to the curriculum of the Secondary Schools of the community.

(2) To encourage increased interest in earth science adult education, on the non-professional (amateur) level, through the medium of club and society activities, and through organized classes in adult education,

(3) To serve as a proving ground or model for like efforts to be undertaken by similar organizations throughout the country.

These objectives are in keeping with the general plan of the American Geological Institute and the American Federation of Mineralogical Societies, with which ESCONI is directly associated through affiliation with the Midwest Federation, set up for the express purpose of advancing Earth Science Education of every kind, by all practical means.

Earth Science Week, in Downers Grove, was an integral part of an initial plan for a broad, far-reaching educational advance program, in which it is hoped many organizations will willingly participate. These should include all geological societies and associations connected with the A.G.I., the Public Information Office of the U.S.G.S., and the informational sections of the State Geological Surveys; college and university departments; state and local Academies of Science; museums; and the many clubs and societies now affiliated with the American Federation of Mineralogical Societies through their regional Federations.

It is intended to serve not only as an inspirational incentive, but also as a pattern of action which, with minor variations made to fit local situations, should prove helpful to those desiring similar activities in their own communities.

Formulating a Working Plan for carrying out an *Earth Science Week* is very important for without adequate preparation the whole program may fall short of the results anticipated in the beginning. Selecting a General Chairman, who has both tact and executive ability, should be the very first step. He should supervise the selection of sub-chairmen, who in turn should be allowed to select committeemen as required. Small committees often accomplish better results than large ones. The Planning Committee should select only

those activities which might be attempted with reasonable expectation of their meeting with popular response and success—it should be remembered that it is impossible to do "all things for all people." It would be much better to select fewer projects and to do them well, than to spread the effort so thin that it makes little impression upon anyone.

The following committees are considered essential:

(1) Planning
(2) Public Relations
(3) Publicity
(4) Educational (Schools)
(5) Educational (Clubs)
(6) Talks and Lectures
(7) Window Exhibits
(8) Mineral Hobby Show
(9) Field Trips
(10) Permanent Follow-Up

(1) *The Planning Committee*—first select a suitable date for the effort; decide upon the number of types of activities to be undertaken; and appoint necessary committee chairmen to put through the entire program. The selection of a proper date is perhaps the most important item. Since field trips of various kinds would seem to be a "must" in the week's program, weather is a factor to be considered. May, coming before the close of school in the spring, and October, after the rush period of reorganization following the opening of school in the fall, make these dates seem most desirable. The week selected should coincide with that of the regular monthly meeting of the local Society, which naturally should also be the date chosen for the principal lecture-meeting of the week. The guest speaker should be the very finest obtainable, since this item and the field trips are the best points around which to base the publicity campaign, especially insofar as the press is concerned. The committee at Downers Grove were exceedingly fortunate in securing Dr. David M. Delo, Executive Director of the AGI for their principal guest speaker on the evening of October 12th. His excellent lecture entitled "*The Earth and the Citizen*," drew a large and appreciative audience.

* * *

The duties of the *Public Relations* and the *Publicity Committees* are closely related, and may often be consolidated into one committee. The responsibility of the *Public Relations Committee* is to contact and explain to those in authority, the full scope, plan and purpose of the proposed "Earth Science Week," so that when the idea is presented for action it will receive favorable reaction and the cooperation of all interested parties. This effort should be directed especially towards school officials and board members, newspaper editors, service club chairmen, secretaries of the Chamber of Commerce, etc. The *Publicity Committee* should attend to and direct necessary public announcements in schools, clubs, over radio, etc.; prepare the publicity and announcements to be used by the press, including the proper timing for publication; prepare copy, and attend to printing and distributing all posters, window cards, hand bills, etc., as may be deemed necessary. At Downers Grove the local papers cooperated splendidly, and some publicity was also obtained in the metropolitan press of nearby Chicago.

* * *

The Educational Committee is one of much responsibility insofar as permanent results may be expected. Through cooperation with the Superintendent of Schools and individual school principals, it may be possible to arrange for special speakers to appear before school assemblies, especially by the use of appropriate moving pictures, and for representatives of clubs to appear before class sessions in "general" and other branches of the natural sciences, with talks upon elementary Earth Science topics which will tend to interest students in the subject. These talks may be illustrated by exhibits of mineral specimens, crystals, fossils and examples of the lapidary art and other material. Ordinarily, children have vivid imaginations and talks of this nature may well create an interest that will influence them to become life long Earth

Science devotees, or possibly direct them into other scientific channels which may become their life work.

Many Service Clubs, Women's Clubs and other cultural groups will welcome outside speakers who can contribute subjects which are new and different to their programs. Members of these organizations are unusually alert and wide awake, and once interested, will make excellent prospects for club membership. After they become devoted to some phase of Earth Science as a hobby, they will do much to influence public opinion toward the introduction of the subject into school curricula. Presentation of programs before such groups is probably one of the best forms of missionary work which club members can carry on.

* * *

Mineral Exhibits and Hobby Shows, if properly conducted, perhaps attract more attention and interest more people than any other form of Earth Science endeavor. These activities may develop along several lines, such as: (1) *Store Window Displays.* A wide variety of exhibits may be placed in store windows, and the merchants in Downers Grove were very cooperative in this endeavor. Some twenty-five or thirty displays were arranged. Many small displays, each showing and telling some simple specific fact or phase of Earth Science study, was thought to be more effective than a few much larger, more comprehensive exhibits. Busy people passing by on the street will take time to look at, or read the legend connected with a small display, but would be discouraged from examining a whole window filled with hundreds of odds and ends.

The ESCONI committee designed and used a unique placard, shown in the accompanying photo. It has general information suitable for all exhibits at the top; an open space in the middle, where specific information concerning the individual exhibit might be hand printed; and information of general nature concerning the occasion and sponsor at the bottom. The uniformity of the cards immediately attracted at-

Typical poster and specimen for window display.

tention to the exhibit in the window and since it was only necessary to hand print the specific information in the center space, much labor was saved.

(2) *School Exhibits* are especially worth while. Temporary cases might be placed in corridors, science class-rooms, or in the school library where they would be seen by all of the students. Quality should be stressed rather than quantity, and illustrative material with special eye-appeal is most effective. All specimens should be *properly* and *effectively labeled,* with some short sentence to add to their educational value. Following such exhibits, student mineral clubs frequently may be established, provided some teacher can be found to sponsor such extra curricular activity.

(3) *Hobby Shows* are so common among Earth Science Organizations that one scarcely need describe their technique. Unless the Club sponsoring Earth Science Week has large numbers of workers available, it would perhaps be best not to attempt a show in connection with Earth Science Week but to put one on at some later date when all forces would be able to concentrate on an all-out effort.

Field Trips during Earth Science Week at Downers Grove proved to be a fitting climax to this very profitable venture. Two field trips were held at the close of the week, one a geological field trip on Saturday and a collectors' field trip on Sunday. This worked out splendidly from several angles. First, there may be those who are more interested in geological investigation than they are in minerals and vice versa; and second, many business men and other workers could not get away on Saturday because of their responsibilities but could very well go on Sunday.

(1) The geological field trip on Saturday, was given under the auspices of the Illinois State Geological Survey, with Dr. Gilbert O. Raasch directing. The forenoon was devoted to the study of glacial morainic deposits, and the afternoon to the limestones of Silurian age exposed in the pit of the National Stone Company at Joliet. (2) The Sunday field trip was a joint meeting of all Earth Science Clubs of the Chicago area, gathering at the famous Wilmington strip mines of the northern Illinois Coal Company, for the purpose of studying the Pennsylvania deposits and collecting the nodular Coal Measure fossils of that age. Dr. Ben Hur Wilson served as field marshall, and interesting and instructive talks were given at the noon hour by Frank L. Fleener and Melbourne McKee upon the geology and conservation of the area. Both were all day trips, and were well attended.

* * *

Permanent Follow-up Committee: This committee is perhaps, one of the most important of all, since without a well planned "*follow-up*" program, little permanent advance may be expected. This follow-up work may branch out in several directions: (1) without too much effort it should result in greatly increased interest in local club work which soon will be reflected in a substantial growth in membership; (2) it should greatly stimulate such features as mineral collecting, lapidary work and field trips; and (3) it should create a stronger demand upon school authorities, and help sell them on the idea that Earth Science is an important field of knowledge, now being sorely neglected in the present school curriculum. It must be remembered that curriculum changes cannot be often brought about quickly, or without opposition, but if the school authorities can be and are convinced that changes are needed, the desired results will ultimately come through.

* * *

RADIOCARBON DATING

(*Continued from page* 14)

best, grass, cloth and peat, antler or hairy structures, and well-preserved shell are next most valuable in that order — must be carefully prepared. The sample must be large enough to yield about half an ounce of elementary carbon. Pure charcoal serves in half an ounce amounts; a quarter of a pound sample must be used at the start if the sample is shell. And even larger amounts of mixed samples are required.

The pure carbon is washed and purified by acid several times, then dried and ground into the consistency of powdered sugar before being placed in the counter.

For counting purposes, a 48-hour period inside the shielded counter gives an age, which is accurate to within three percent, providing the sample was uncontaminated when received. Libby's book describes the process in great detail as an aid to other scientists in extending the measurements to many other samples. So far, Libby and his associates have tested about 250 samples of archeological and geological interest. A complete listing of the results of these tests is included in the book.

—University of Chicago
Office of Press Relations

The Scope of Earth Science

by William H. Allaway
Chairman, Earth Science Club of Northern Illinois

"Earth Science" is a popular term used to include all the many branches of scientific knowledge which deal with the origin, history and development of the earth and its inhabitants. The Germans called this subject "Erde-Kunde" (Earth Knowledge) two generations ago, when it was introduced into American schools for the first time. As usual, desiring some more high-sounding term, American educators adopted the word "physiography," which proved unfortunate. The very name frightened students away and the subject today has practically disappeared from the curriculum of the Country's secondary schools, being taught in less than six percent of our high schools.

The few more progressive schools which still teach the subject have improved and broadened their courses to include many phases of earth knowledge unknown in the days when Grandfather studied it as "physiography." Present day teaching, if it is abreast of the times, includes not only a review of the earth's features, but a study of fossil life, structure of minerals, and meteors, conservation of the earth's riches and some explanation of how atomic energy is produced from the elements. Such subject matter has considerable carry-over value into the biological and social sciences and its true worth as a splendid orientation course is being recognized more and more. As the science broadened beyond the scope of physiography the need for a more descriptive name became apparent, so today we have EARTH SCIENCE.

What does Earth Science teach? In modern terms it tells us about the earth's history, how it started, and how it grew. It also teaches that the earth's surface is constantly changing, due to a "cycle of erosion," caused by the action of rain, wind, water, ice and snow which breaks down rocks into fragments, carries these fragments to new locations, and deposits them as a soil. We discuss what causes volcanoes, mountains and glaciers, and how new rocks are created from the sediment of the old. Fossil remains of both plants and animals provide a fascinating record which tells us how our present forms of life on earth came to be.

One of the first things we learn from the book of Earth Science, is the law of change. Nothing ever remains the same from one moment to the next. Changes may be slow and gradual or explosive and cataclysmic, but the end result is always—change. Great changes have taken place in the earth's crust, transforming the configuration of the continents from one geologic age to the next. At times, for example during the Pleistocene Epoch, much of the earth's surface has been buried under huge sheets of glacial ice and to the grinding action of the glaciers we owe the present rich soil base of Northern Illinois.

Physics teaches us that the earth's crust is composed of elements, "nature's building blocks." Groundwater, underground cooling, or distillation may concentrate valuable elements where man can later mine them as precious metals, for example — gold, silver, platinum, etc. When elements chemically unite into natural compounds, they form the numerous members of the mineral kingdom. A rock is nothing more than a mixture of minerals and in their examination we are introduced to the subjects, mineralogy and petrology, two important branches of Earth Science. We find that minerals are classified according to their chemical relationship and that all rocks fall into three great family groups according to the way they were made: (1) Igneous, or heat formed rocks; (2) Aqueous, or water formed rocks; and (3) the Metamorphic rocks which are either of the

other two classes which have been changed by heat, pressure or the work of ground waters.

It is scattered among the later sedimentary rocks that we find evidences of one of the great miracles of the universe—the evolution of living things on earth. Primitive fossils have been found in the rocks laid down prior to the Cambrian Period, however, life had already evolved long before this time. Some types of fossils always occur in certain formations and these we recognize as "Index Fossils." They tell a consistent story wherever they are found, as these horizon markers lived for only a short interval of time and thus identified certain strata wherever they occur. Through the study of such fossil remains, we can correlate various geologic ages back to the time of the beginning of life on the earth.

Finally in the long, continuing evolution of the life on the earth, man appears and the student of primitive peoples and civilizations takes over where the student of rocks and minerals leaves off. There are yet many gaps in the story of ancient man on the earth, but the archaeologist digs on, patiently fitting together and recording the evidence of his crude beginnings. In his studies, he continually has to refer to many geological matters, particularly since man, emerging from a state of abject savagery first lived in the "Stone Age" in his climb up the ladder of civilization. Many facts uncovered by the archaeologist stem from a study of the materials from which these stone artifacts were made. It has been learned that clays of certain types had first been brought in from great distances before landing on the "Potter's Wheel." Man's early dispersion and trading habits may be traced by his use of gems and other minerals. Certain gem stones used by primitive man in countries north of the Mediterranean Sea, for example, were mined deep in the continent of Africa. While some might dispute the fact that archaeology is a rightful branch of Earth Science, "Minarchaeology (Man's prehistoric use of minerals) is certainly a closely related subject.

Lest we gather the impression that Earth Science is purely a physical study, we must remember that science in its broadest sense is more than observing, experimenting and accumulating objects, facts and theories. It also involves the communication of these basic facts and the exchange of ideas about them. In short science (and that includes Earth Science), is a social activity. It involves the passing on of one person's finding and observation to another. Without this process of communication, the findings of the greatest geologists or archaeologists would be lost forever. Earth Science as a science must extend itself beyond the individual or it operates in a vacuum.

The professional earth scientist earns his living in his chosen field and that living very often is rough and rugged. He may work as a petroleum geologist, as a consultant in one of its many branches or as an instructor in our halls of learning. His work may be highly specialized, or it may cover a more general field. In any event a person who chooses this type of work must be motivated by a great interest in his vocation, for we find few of them who ever seem to be overpaid.

The non-professional earth scientist, facetiously known as a "Rock Hound" if his main interest lies in rocks and minerals, or a "Pot Hunter" if he devotes his spare time to archaeology, has contributed a great deal to our general knowledge of the Earth Sciences. Throughout the country, like-minded enthusiastic amateurs have organized into clubs and societies devoted to the study of several of all branches of Earth Science. These groups are often sponsored by schools, museums and social centers, giving interested people the opportunities to attend lectures and field conferences led by competent scientists. This provides a refreshing avocation for office and job-weary people who desire to gain some knowledge of their natural environment and at the same time develop friendship with like-minded enthusiasts in a healthy outdoor activity. Equipped with a fund of reliable information, a little technical training, and much enthusiasm,

these people are then in a position to convey some of the meaning of the earth sciences to others and especially to develop interest in the subject on the part of the younger generation. They are also preparing themselves to play a part in developing well informed public opinion in these disciples. Our world is now perplexed with many problems involving great need for a knowledge of Earth Science in solving the problems that are now facing this country, and they will not wait forever for a solution.

What is "Earth Science" and what does the Earth Scientist do? The name has been defined, its meaning and effect from the point of many people has been described, and it has been intimated that it is basically a social activity. However, in order to really come close to a comprehension of Earth Science we must realize that since the earth is our natural habitation for the duration of our lifetime, we should strive to understand and appreciate it so that we can derive the maximum benefit from our sojourn here.

Through the work of earth scientists the deserts have been made to bloom, an abundance of food for a greatly increasing population has been provided, the fuel supply for an ever increasing amount of industry has been made available and power has been produced for our revitalized Southern States by such governmental projects as the T.V.A. These accomplishments have been achieved and many more projects are even now under discussion.

It will be the earth scientist who will make the surveys and provide the information to make these projects possible. Who is in a better position to appreciate the wonders of nature than the persons whose vocations and avocations are followed in the great outdoors, into the mountains and far away places, carrying with them the scientific knowledge and power to make this world a better place in which to live?

This is why so many enthusiastic "Rock Hounds" are so busily engaged in promoting Earth Science activities in all its various phases. More power to the entire tribe.

THE TRILOBITA

by James O. Montague

The Trilobita is an extinct crustacea of the Arthropoda phylum or family, which comprises a very large and varied group of highly developed invertebrates, with a long geological history reaching back to, or into the Pre-Cambrian. The members of the phylum have left their fossil remains in the sedimentary rocks from the very earliest Cambrian up to the present time. They have been very successful in adapting themselves to the many geological changes, and through this adaptation they have invaded every life habitat. The crayfish, crabs, centipedes, millipedes and scorpions are familiar representatives of the Arthropoda phylum.

The Trilobites were marine animals. The exoskeleton, or outside shell, with which all were covered, allowed a limited expansion so when the animals increased in size it became necessary for them to periodically shed their coverings. The new exoskeleton which was secreted after moulting was somewhat larger than the preceding one. During the growth period the animals assumed new characteristics after each moult until finally the adult stage was reached. After the adult characteristics of body had been acquired, the moulting periods occurred at intervals until the full body size reached maturity. Their moultings always took place near a coral reef, and it seems from the evidence left near these bioherms that they had favorite or protected places in which to moult. All of the moults found do not represent separate animals, as each animal made many moults during the growth period. This may account for the great abundance of fossil trilobites in some formations.

The only portion of the fossil trilobite that is commonly preserved is the hard exoskeleton covering the dorsal part of the body. This test, or carapace, is very thin, rarely more than a millimeter in thickness, sometimes much thinner; it consists of a chitinous material cemented with calcium phosphate. In many silurian fossil trilobites, which

are casts of the original, no chitinous material remains. In most cases only portions of the cephalon, or complete cephelons and pygidiums are found. Sometimes the thorax segments are found separate or a few of them attached to a pygidium. The calymene is the one generally found with the dorsal side complete. The carapace is usually suboval in general form, rounded at both ends, and almost always longer than wide, and is usually convex transversely. Longitudinally it is divided by two dorsal or axial furrows into three lobes, a characteristic which first gave these animals the name trilobites. The axis, or central region, in the living animals contained the vital organs, the viscera, heart, and nervous system. The two lateral regions are called pleura, or pleural lobes. The body is also divided transversely into three parts, the cephalon, or head; the thorax, and the pygidium or abdomen. The margin of the carapace is bent under to form a reflexed margin or doublure, which is separated from the dorsal side by a narrow space and forms the hollow spines at the end of the thoracic segments, also the infolded edge of the cephalon and the pygidium.

Two forms have been noted among some genera of trilobites, the broader and larger which is thought to be the male, while the smaller and narrower is considered the female.

The cephalon, or head, of the trilobite comprises the anterior one of the three transverse parts of the test. It may range anywhere from semicircular to sub-triangle in form, some of it is very large in front. The posterior margin may be slightly curved or almost straight. The general angle formed between the posterior and lateral margins may be posterially extended into a genal spine. In some genera the genal spine is absent. The cephalon consists of the glabella, a face, fixed cheeks and hypostome, or under lip. The glabella is the anterior part of the axil lobe and may be either smooth or segmented. It is transversely divided by glabellar furrows into two or more longitudinal lobes, the largest being the frontal lobe, and the others being noted as the 1st, 2nd, 3rd latteral glabellar lobes and an occipital segment. In some forms the glabella may constitute a great part of the cephalon, in others a very small portion of it.

The pleural, or side regions of the head are called cheeks. In a great majority of trilobites the facial sutures divide each cheek into two portions. Some trilobites were blind, others had a single eye but most of them had compound eyes which were situated on the free cheeks. These compound eyes were composed of many facets which ranged from a few in some genera to a maximum of 15,000 in others. The portion of the cheeks lying between the facial sutures and the dorsal, or axial grooves, are called fixed cheeks.

The hypostone, or under lip, is a separate plate situated mostly in a horizontal position on the ventral side of the cephalon.

The thorax of the trilobites consists of two segments in some genera to as many as twenty-nine in others. They join and overlap lengthwise. Each thoracic segment is composed of the central or axial portion lying between the axial furrows. The axial part is more or less convex transversely while the pleura are mostly depressed below the axis and are more or less flattened. The axial or central lobe which contained the vital organs is divided from the pleural lobes by dorsal or axial furrows.

The pygidium, or abdominal part of trilobites, like the cephalon and thorax, consists of an axial lobe with two pleural lobes which were separated by axial or dorsal furrows. The pygidium consists of a single piece with the original segmentation mostly preserved with the axial furrows longitudinally separating the axial lobe from the pleural lobes. Some genera have a caudal spine while others are smooth.

Very little was known about the ventral side of trilobites because of its being so firmly imbedded in the matrix that practically all of it was destroyed. By sectioning rolled trilobites some knowledge was gained of the thin

ventral shield and appendages. Since triarthus becki, green, was found in the Utica slate near Rome, New York, the ventral side has been made out in great detail which is now regarded as being typical of most trilobites. Each segment carried a pair of jointed appendages and each appendage consisted of a basal joint and two branches, the inner branch having six joints which were attached to the basal joint. The outer branch had one long joint which was fringed with long setae making an almost continuous fringe. A pair of antennae extended anteriorally from the hypostome, or mouth, which acted as feelers. The appendages were used for either crawling or swimming, or both.

The trilobites dominated the scene during the Cambrian and Ordovician periods. They reached their culmination at the close of the Ordovician and began their decline in the Silurian period; when the giant cephalopods began to dominate the scene they must have preyed upon the trilobites and started their decline. This decline was greatly accelerated with the advent of vertebrae fish. Their habit of folding was no protection against the fast-swimming fish. The decline became greater through the Devonian, Mississippian and Pennsylvanian periods with final extinction in the Permian period. All in all they were quite husky to last for 368 million years. The trilobites have left their fossil remains in the sedimentary rocks in all parts of the world and are considered one of the best, if not the best index fossils of the Paleozoic Era.

The following publications have been a great help in preparing this article.

HISTORICAL GEOLOGY — Moore — McGraw-Hill Publishing Co.

INVERTEBRATE PALEONTOLOGY — Twenhofel & Schrock—McGraw-Hill Publishing Co.

INDEX FOSSILS OF NORTH AMERICA—Shimer & Shrock — The Tecnology Press

THE CHICAGO ACADEMY OF SCIENCE—Stuart Weller, Bulletin No. IV

THE TRILOBITA—Part II

THE PALEONTOLOGY OF THE NIAGARAN LIMESTONE IN THE CHICAGO AREA

* * * * *

EARTH SCIENCE EVENTS AS REPORTED BY W. H. ALLAWAY

From President Z. H. Vanleurn, M.D. of the North-West Michigan Mineral Club. Judging by the number of their members now hunting rocks out west, this is a busy club. Wish we had the space to print the list of places for hunting rocks he sent us.

From Edgar R. Wright of the Fort Randall Gemites. Apparently there is considerable activity recently in exhibiting lapidary work. Although a new club, they have 26 "Pebble Pups" (our future geologists). A unique feature of this club is their emblem, a green jade triangle that each member makes and wears.

From Domer L. Howard, Editor of the "Sooner Rockologist" of the "Oklahoma Mineral and Gem Society." This club is studying the "Quartz Family Group" and a practical demonstration of the art of faceting occupied their attention for their April meeting. I found this little gem in their bulletin.

"Of all the gems I've ever seen,
My favorite is the Tourmaline."

From Mrs. Maud Kelley, Secretary of the "Minnesota Mineral Club." Their April meeting contemplated a talk on "Pearls" by Mrs. Smart, on "Opal" by Mrs. Dana Rogers and "Gem Lore of the Orient" by Mrs. Spaulding. Sounds like a busy and interesting evening.

From May A. Huss, Editor of the "Marquette Geologists Association," "M.G.A." Bulletin of Chicago, Illinois. "Fundamentals and Phenomena of Black Light," was the topic of their April 5th meeting. Their auction and talks on "Agates" and "Amygdaloyds" by Drs.

Fleener and Wilson of the "Joliet Mineralorist Society," constituted their May meeting. This is a busy club and the writer thoroughly enjoyed visiting them at their March meeting.

From Conrad F. Oakland, Editor of the "Trilobite," bulletin of the "Wisconsin Geological Society." Their April 7th meeting scheduled a Kodachrome lecture by Mr. Thomas Scanlon of the "Marquette Geologists Association" about his 8,000 mile field trip to and from the 1951 "American Federation Convention." Sounds like a "rock hound's" dream of Heaven.

From Herbert F. Grand-Girard, Editor of the "Pick and Dop Stick," bulletin of the "Chicago Rocks and Minerals Society." The topic for the April meeting was "Spelaeonology," and the speaker was Mr. Hugo Herschend of Wilmette, Ill., owner of the "Marvel Cave," near Branson, Missouri. On May

(Continued on page 35)

April 30, 1952

Dr. B. J. Babbitt, *Editor*
THE EARTH SCIENCE PUBLISHING COMPANY, INC.
Dear Dr. Babbitt:

As President of the Eastern Federation I take this opportunity to invite all other Federations in the National Federation, also all non-member Societies, to participate with us in our Second Annual Convention to be held in Newark, New Jersey on October 9-10-11, 1952.

The Convention headquarters and display rooms will be located at the Essex House in Newark and ample space has been provided for both commercial and non-commercial exhibits to house a wonderful show. An outstanding feature of the Convention will be a field trip to Franklin Furnace to collect fluorescent minerals. The committee has secured permission from the Buckwheat Mine to have a bulldozer turn over the old dump and spread it out so that collecting will be made easy. This is the first time that anything has been done along this line and goes to show what can be done when you have a responsible organization contacting the owners. All members that register will be allowed to collect free of charge; all others will be charged one dollar each for that privilege.

The roster of the Eastern Federation is growing steadily and before long we confidently expect to have a Federation that will be second to none. We have some very fine collecting fields with a wide range of minerals and some of the finest museums in the world are located on the Atlantic Seaboard. We strongly suggest that any society anticipating joining the Eastern Federation make its application right away so that it will be assured of being listed in the Eastern Federation Directory which will be distributed at the convention. Member societies will receive a copy of the directory without charge.

Very truly yours,
Harry L. Woodruff, *President*
Eastern Federation

EARTH SCIENCE QUIZ NO. 1

Test Your Knowledge! How much do you know? How many of the following terms can you define? They are arranged in three groups with progressive difficulty. Group 1, things everybody should know; group 2, things good "rock-hounds" should know; group 3, things which experts might be expected to know. Try your luck. To score—add up total points as indicated by the group number and rate as follows: 1-6 poor; 7-13 good; 14-20 excellent; 21 perfect.

a.—(1) stalagmite
b.—(1) $CaCO_3$
c.—(1) diamond
d.—(1) hydrate
e.—(1) gangue
f.—(1) hexagonal
g.—(2) plaster-of-paris
h.—(2) coquina
i.—(2) cone-in-cone
j.—(3) pseudomorph
k.—(3) pleistocene
l.—(3) patination

(for answers, see page 35)

3rd and 4th they visited the "Kettle Moraine country" in Wisconsin with Dr. William Powers of Northwestern University as lecturer.

From Harry L. Adams, President of the Mineralorist Society of Joliet, Ill. On April 22nd, Mr. Jay E. Farr, of the "Earth Science Club of Northern Illinois," talked on "Gem Stones of the Bible," and displayed these ancient stones. Actually they are the same as modern gems except for a more scientific cut and the fact that most of the names have changed down through the centuries.

From Bernice Wienrank, Editor of the "Template," bulletin of the "Chicago Lapidary Club." Mr. Henry Cox, Jr. filled the rostrum at the April 3rd meeting, describing the technique of "Making Jewelry from Abalone Shells," which he learned from a native on Guadalcanal.

(*Continued on page* 36)

Answers: *Test Your Knowledge.* Check ones which you have answered correctly.

a.—(1) Calcarious stump-shaped formations occurring on the floor of caves.
b.—(1) The chemical formula for calcium carbonate (calcite, limestone, etc.)
c.—(1) One of the allotropes of pure carbon in its crystalline form.
d.—(1) A mineral holding one or more molecules of water, in addition to its base formula.
e.—(1) Non-valuable minerals associated with an ore (waste material).
f.—(1) A six-sided figure or prism.
g.—(2) Calcinated gypsum in pulverant form. A plaster.
h.—(2) A shell breccia. Rock common to Florida.
i.—(2) A curious structure found in clay rocks whereby two opposing and interlocking sets of cones or pyramids are developed.
j.—(3) A crystal of one species of mineral masquerading in the form of another.
k.—(3) The geologist's name for the last "Great Ice Age."
l.—(3) A dull layer or coating formed on the exterior of a mineral substance through chemical alteration such as oxidation or physical deterioration.

Total_____ Score: 1-6 poor; 7-13 good; 14-20 excellent; 21 perfect.

From Mrs. Dana A. Rogers of the Earth Science Society of Rochester, Minn., who has sent us a report of a fine field trip to the "driftless area" of Wisconsin. We hope to publish this at a later date.

From Charles M. Schwab, Editor of the "Nebraska Mineral Club" bulletin, "Rear Trunk," we hear of the many activities of their Junior members. We would like to see evidence of this kind of activity in all of our Mineral clubs throughout the country.

From Miss Janet Pattee of the "Cedar Valley Rocks and Minerals Society," we find that Mr. H. R. Straight of Adel, Iowa, was scheduled to talk on "Identification of Fossil Woods," at their recent meeting.

From Fern and Olin Brown, Co-Editors of "Mineral Minutes," bulletin of the "Colorado Mineral Society," they indicate that "Coloradoites" do collect minerals in the east. Their Vice-President Calvin B. Simmons told about his collecting activities in the Eastern United States, at their April meeting.

From Ivan W. Root, Secretary of the "East Bay Mineral Society" of Oakland, Calif., greetings are sent from the far west. From their April agenda it is now apparent why there are so many people interested in Earth Science subjects out that way. Mrs. Ward Lewis talked on "Why I Have a Mineral Collection," Mrs. R. M. White talked on "How to Make Solid Jade Rings," and Mrs. Harry Burnett reviewed the book "Vermillion," by Idwal Jones. This is an innovation that should be adopted by other clubs, namely, "Women's Night."

From E. N. Smith, President of the "Geode Rocks and Minerals Society," of South Eastern Iowa. At the quarterly meeting on April 10th, members of the Development Committee of Geode State Park & Lake were the guests of honor. A wonderful display of geodes captured by Earl Smith, Secretary and Treasurer of the club formed the exhibit of the evening. The matched halves of 8 great geodes, ranging from 110 to 40 lbs., were all taken from the same shelf. This

(Continued on page 37)

FOSSIL IN THE CRANNIED WALL

O fossil in the crannied wall
I chip you from the cranny—
No life snuffed out to slake the thirst
Of curiosity,
Or knowledge of creation's dawn
So steeped in mystery.

Fear not—your likeness did not fall
To vandal's violation
Your replica has now become
A point of adoration,
Beheld with reverence and awe—
No thought of desecration.

Rest on in peace, my sphinx-like friend—
Your everlasting stature
Has spanned the years of ageless time,
Transcendent through the future—
Long after Man and all that's his
Have been returned to Nature.

ESCONI NEWS—*B. J. Babbitt*

EARTH SCIENCE EVENTS

(*Continued from page* 36)

club, while deeply interested in geodes, is also very busy acquiring skill in the Lapidary Arts.

From the "Earth Science News." The "Earth Science Club of Northern Illinois," enjoyed a fine Kodachrome lecture by Mr. and Mrs. Brentlinger on May 9th. These people are well known for their work in lapidary circles. The Archaeological Group of this club is training for a survey of Indian sites in Northern Illinois, under the leadership of Mr. David Wenner. They have field trips scheduled for each month up to October 19th when they will sponsor a two day trip to the Wisconsin Dells.

From all of the clubs we have contacted and introduced above come greetings and best wishes for the success of this new venture. They assure us that they believe this magazine will fill a

(*Continued on page* 38)

EARTH SCIENCE EVENTS

(*Concluded from page* 37)

great need in those territories that have heretofore had no agency immediately available for publicizing their desires, opinions and activities. We extend our thanks and will welcome a deluge of material. The magazine will grow in proportion to the interest shown in it.

GEOLOGIC

(*Continued from page* 11)

Subsurface Structure

The subsurface structure of the rocks beneath the cities is that of a very shallow basin that is more than 40 miles in diameter with the dip of the beds on its sides averaging about 20 feet per mile. The bottom of the basin is quite flat, like the bottom of a saucer. This basin-shaped structure is of great economic importance since it forms a local artesian basin which supplies hundreds of artesian wells in and around the metropolitan area.

Points of Special Interest

1. Minnehaha Park, Minnehaha Falls and cliff at Lock and Dam at Ford Motor Co. plant.
2. Junction of Mississippi and Minnesota rivers at Ft. Snelling.
3. Shale quarry of Twin City Brick and Tile Co., St. Paul, to collect fossils from Decorah formation.
4. Limestone quarry between Mendota and Cherokee Heights to collect fossils from Platteville formation.
5. Numerous gravel pits for agate and other mineral specimens.

ETCHING

(*Continued from page* 22)

As to designs; letters, numerals, monograms, etc., present this problem—the slightest imperfections of outline are readily noticeable and because of the fineness of the design, extremely hard to avoid. On the contrary conventional floral designs, wreaths, lodge symbols, maps (see Globe illustrated), etc., do not present this problem. It might even be possible to make cameo type etchings of profiles—for example of Franklin or Washington as shown on

1894 and earlier stamps, or of your wife or daughter from a snapshot of suitable size; the stencil to be made by careful cut-out glued to the subject stone.

You'll find that the mechanical problems are simple, and that the required equipment is well within the reach of most of our purses. The matter of design and execution, however, is a challenge to our very best abilities, and nicely done work makes a fine and worthwhile addition to our collection—as I said before, a brightly gleaming added facet to our Gem Hobby.

BOOK REVIEWS

ENERGY SOURCES, THE WEALTH OF THE WORLD, by Eugene Ayres and Charles A. Scarlott. New York: McGraw-Hill Book Co., 344 pp., $5.00.

"Histories written a few centuries hence may describe the United States as a nation of such extraordinary technologic virility that we succeeded in finding ways of dissipating our natural wealth far more rapidly than any other nation. At any rate, we are having a wonderful time doing it," write the authors of *Energy Sources*, which is both a critical appraisal of the extent of our reserves of oil, coal, water power and other energy sources, and a prediction of future energy practices.

The United States is face to face with an energy crisis, they find on the basis of an elaborate statistical analysis of the depletion of our fossil fuels—petroleum, natural gas, and coal—and of the growing demand for energy. The former are only good for a limited number of years, and usable veins of coal are nearer used up than the figures on coal reserves indicate. Besides, our civilization is demanding liquid fuels and electric power, and conversion of oil and coal into these convenient forms itself causes a large energy loss, so that it is possible to show that as we become more efficient in the use of machinery we become more inefficient in the use of power.

These conclusions are based on solid

facts. Conclusions for the future are highly informed guesses, of course, and, fortunately for the reader's peace of mind, they are optimistic. Ayres, who is technical assistant to the executive vice president of Gulf Research and Development Company, and Scarlott, editor of the *Westinghouse Engineer* discount nuclear energy as of general value, but they are confident that "man's resourcefulness continues on and becomes more potent with each passing decade." Specifically, they believe that utilization of low level heat, such as is made available by the heat pump, and direct employment of solar energy, through photosynthesis and other photochemical reactions, and space heating by use of solar windows, etc., will provide amply for the future.

Energy Sources is eminently readable, despite its statistics, and it even manages to make some of them exciting. As a thoroughgoing and serious study of one of the world's major problems, it deserves the widest consideration and influence. If it accomplishes nothing more than to make plain that we are nearing the end of our fossil fuels and must make provision now for energy sources for our children—that the crisis is not far off but is near at hand—it will have done a great service.

SOIL ENGINEERING, by Merlin Grant Spangler. Scranton, Pa.: International Textbook Co., 458 pp. $6.50.

The earth is the ultimate foundation of all man made structures, so that an understanding of its properties is fundamental to all building operations. This book by a professor at Iowa State College, although cast in textbook form, contains a great deal of material of interest to the earth scientist as well as to the engineer. The origin and nature of soils, soil profile classifications, effects of water on soil properties, its strength and load bearing capacities, and methods of testing and sampling are among topics treated at some length. Although not an elementary book in its presentation, most of the material is not beyond the grasp of the interested layman.

TABLES FOR MICROSCOPIC IDENTIFICATION OF ORE MINERALS, by W. Uytenbogaardt. Princeton, N. J.: Princeton University Press, 1951, 242 pp. $5.00.

This book is a must reference book for the ore mineralogist who wishes to study the opaque minerals in the reflecting-light or metallurgraphic microscope. About 350 minerals are listed in the 181-page identification tables in order of increasing hardness or "resistance to polish." Galena, chalcopyrite, and pyrite are used as standards of comparison in this property of polishing hardness. Also listed in the tables are the composition and crystal form, the Talmage hardness, reflectivity, color, etch reactions, and considerable miscellaneous detail for each mineral. Two lists are also given in addition to the main table listing (1) the minerals in the order of increasing polishing hardness with reflectivity values and their isotropic or anisotopic character and (2) the minerals listed in order of increasing reflectivity. These latter values have been determined by either photoelectric cell measurements or by photometric ocular studies.

An annotated list of 75 superfluous ore mineral names is included. These are minerals identical to another mineral known by another name, or are intergrowths of two or more other minerals, or are not valid species.

A bibliography with a list of 421 references is included, which brings up to 1949 the earlier list of Schneiderhohn-Ramdohr in 1931 on this same topic of ore mineral identification.

ALCOA, AN AMERICAN ENTERPRISE, by Charles C. Carr. New York: Rinehart & Co., 292 pp. $3.50.

The Aluminum Company of America, whose history is the subject of this book, is one of the largest mineral enterprises in the world. The clays and other aluminum minerals are among the abundant constituants of the earth's crust, but they were hopelessly locked in chemical combination until Charles M. Hall, young Ohio chemist, made the electrolysis of bauxite in cryolite a practical process for manufacture of

aluminum. That was in 1886, and in the subsequent years, as Mr. Carr, former director of public relations for the Aluminum Company, tells it, the company grew great on its development of American bauxite deposits, hydroelectric power, its enterprise in finding uses for the light, bright metal, and its stout hearted defense of its often questioned ways of doing business.

THE TECTONICS OF MIDDLE NORTH AMERICA — MIDDLE NORTH AMERICA EAST OF THE CORDILLERAN SYSTEM, by Philip B. King. Princeton, N. J.: Princeton University Press, 1951, 203 pp.; 52 figs. $3.75.

This excellent and carefully written book describes the structural features of North America east of the Rocky Mountains. It is largely descriptive in character but also gives the reader an introduction to some of the theoretical considerations. The 52 maps and detailed cross section diagrams are beautifully reproduced and help give a clear picture of the geology of eastern North America. The book starts with a discussion of the Laurentian or Canadian Shield and then takes up the Interior Lowlands, Newfoundland, the Appalachian Mountain system, the Wichita and Quachita Mountains, and the Coastal Plains. Numerous references are included in each section. This volume should serve as a textbook to be used with the Tectonic Map of the U. S. published by the American Association of Petroleum Geologists under the editorship of Mr. King. Mr. King is a geologist with the U. S. Geological Survey.

This volume is planographed on good quality paper in a strong cloth binding. The print is a little light, but easily read. The size of the book is 7"x 10".

STRUCTURAL GEOLOGY OF NORTH AMERICA, by A. J. Eardley. New York: Harper & Brothers, 1951, 624 pp.; 343 figs., 16 pls. $12.50.

This is a monumental volume representing more than ten years of work by Professor Eardley. It is the outstanding book of its kind and brings together more details of structure and tectonics of North America than has

ever been assembled before in one place. It is a general reference book for anyone interested in the regional structure of our continent. It was originally conceived as a textbook for undergraduates, but it has become a textbook and reference book usable by graduate students as well as by all those wishing some glimpse of the structural relationships of the earth's crust as seen in North America. The book is profusely illustrated, containing some 750 maps, diagrams or geologic cross sections, combined in 343 figures. There are 16 full page paleotectonic maps in color.

This book is printed in an unusually large and somewhat awkward size, being 11¼"x 8¼" with a double column page. This extra large size is to make possible some of the long cross section diagrams. The content of the book actually is equivalent to two good size volumes. The printing is good, and the illustrations are reproduced with excellent clarity.

The book by Philip King, *The Tectonics of Middle North America*, covers part of the same information as that included in Earley's book. However, these two men have included somewhat different details and have written their books with enough difference of interpretation so that the amount of duplication in the two books is relatively slight. The student of the structural geology of North America should consult both books.

BULLETIN OF THE GEOLOGICAL SOCIETY OF AMERICA. Published monthly by the Society, 419 West 117th Street, New York 27, N. Y. Subscription $15.00 per year.

This bulletin presents outstanding articles in various fields of geology with an average of 2-5 articles per number. The twelve issues representing a year's subscription usually run to about 1,400 pages. Many of these articles are highly technical, but are usually well illustrated with maps, diagrams, and photographs.

Of particular interest in late issues is an article in Volume 63, No. 2, for February, 1952, pages 167-224, by W. F.

Prouty, entitled "Carolina Bays and Their Origin." Along the Atlantic coastal plain from northeastern Florida to southeastern New Jersey, there is an estimated half million of these so-called bays. These bays are located a considerable distance from the shore and exist today as lakes, swamps, and in some cases as land areas. They are elliptically shaped depressions which range in size from a half mile or less in long dimensions to 4-5 miles. Many of these bays or depressions overlap one another. The long axes of these are oriented in a general NW-SE direction. It was suggested many years ago that these bays were formed by a shower of meteor fragments. Subsequently, however, several other theories were advanced which explain their origin. In the present paper, the meteoretic theory is strengthened by much additional data. Magnetometer studies were made of 26 different bays, and in all cases, magnetic high spots were found asociated with these bays.

Altogether, this is a very fascinating article, illustrated by many diagrams and reproductions of parts of aerial photographs. It is a fine example of very careful analysis of factual data to explain the origin of a group of land features. It should be of interest to most earth scientists.

YOUR JEWELLERY, by J. Leslie Auld. Peoria: Charles A. Bennett Co., 131 pp. $2.75.

This is a book every jewelry craftsman should own. By diagram and description it gives the best explanation this reviewer has seen in print of methods of supporting work for hard soldering, or making chains, pin backs and catches, and of fashioning settings for stones. Besides these specially valuable chapters, it contains a systematic summary of basic information for the craftsman about his tools and about gems and gem materials. Besides the instruction usual in such books, *Your Jewelry* also presents sections on chasing, engraving, inlay and niello work, and coloring metals. The generous use

of drawings and some photographs is one of the elements that makes it so useful to the beginner and even the advanced amateur. The author makes some general remarks about design, but in general eschews any detailed explanation because he believes that the craftsman should create his own forms. The author of this book, which is published in England and imported by the Charles A. Bennett Co., is lecturer in design at the Glasgow School of Art.

DANA'S SYSTEM OF MINERALOGY, 7th edition, Vol. 2, by Charles Palache, Harry Berman and Clifford Frondel. New York: John Wiley & Sons, 1,124 pp., $15.00.

Reviewing Dana's Mineralogy is like reviewing the Ten Commandments; it is so complete and comprehensive that there can be no difference of opinion about it.

This, the second volume, describes the mineral halides, nitrates, borates, carbonates, sulfates, phosphates, arsenates, tungstates and molybdates, as well as idoates, selenates, vanadates, and antimony compounds. Salt, fluorite, calcite, azurite and malachite, niter, borax, barite, gypsum, monazite, turquois, autunite, carnotite, wolframite and scheelite are some of the minerals of economic importance in this large group. In the main, however, the minerals described in such detail here are relatively rare and their names are unfamilar to most mineral collectors.

As in the first volume, which described the elements, sulfides, sulfosalts and oxides, this volume groups minerals into species by chemical relationships and treats the minerals as a series rather than as individuals. Major use is made of crystal chemistry and x-ray crystallography in descriptions and in classification. As in earlier editions of Dana's work, which first appeared in 1837, the data are revised from new observations, and extensive use is made of references. One of the principal values of the new edition is its critical examination of nomenclature, its rejection of many names and its use of names that indicate the series position of the mineral.

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*See page 158, Feb. 1951 issue of *Mechanix Illustrated*, for spotting scope plans using this lens.

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